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Introduction

Since 2001, pension freezes have surged in popularity. The recent spurt is the latest extension of the decade-long trend for plan sponsors to shift from defined benefit (DB) to defined contribution (DC) plans.¹ A more mobile workforce and competitive pressures have encouraged the 25-year shift to DC plans, away from the less flexible, more volatile, and higher cost DB programs. A recent confluence of market and regulatory events has increased the popularity of freezes relative to outright terminations. This paper seeks to answer whether freezes actually do increase firm value, as the managers who enact them proclaim. In addition, we study the market's efficiency in recognizing this potential value change. We test these research questions with an event study, using a sample of recent pension freezes from 2003 through 2006. The results address issues important to the managers who execute freezes and to the investors who price their effect on firm value.

Background and Prior Literature

Private sector American workers have long received retirement benefits as a component of their total compensation. Traditionally, firms have provided for their employees' retirement through defined benefit pension programs. DB plans guarantee an annuity payment upon retirement equal to a formula that includes the employee's level of compensation and years of service to the firm.

Examples include the following:

$$(2\%)*(\text{Years of Service})*(\text{Final 3 Years' Average Salary})*(\text{Inflation Index})$$

DB plans insure the retiree against longevity and investment risk, leaving the firm to fund and manage the plan responsibly. Providing for a workforce's retirement creates

¹ Munnell et al. (2006).

substantial long-term liabilities for the sponsor. Unlike social security, DB obligations are not funded out of cash revenue. Rather, the Employee Retirement Income Security Act of 1974 (ERISA) requires plan sponsors to fund an investment trust for the benefit of plan participants. Annually, firms are required to contribute a minimum amount to the fund. By law, companies must contribute to their plan each year an amount equal to the present value of the benefits earned by employees that year. Additionally, the Pension Protection Act of 2006 requires firms to make up for funding shortfalls, generally amortized over a seven-year period.² If managed incorrectly, these post retirement liabilities can have a crushing effect on a firm's solvency and profitability.

A case in point is the struggling domestic auto industry. In 2005, General Motors' legacy costs, including health care benefits, came to \$1,600 per vehicle.³ Competitor Toyota offers no DB plan; and, on a unit of production basis, pays 90% less in health care costs than GM.⁴ Despite an allegedly over funded DB plan, mounting benefit cost pressure forced GM to freeze its pension in Q1 2006.⁵ Besides the expense burden, long-term DB liabilities increase the plan sponsor's risk (market, legislative, accounting standard and actuarial⁶), as GM outlines in its 2006 10K:

Our future funding obligations for our IRS-qualified U.S. defined benefit pension plans and our estimated liability related to OPEB [Other Post Employment Benefits]⁷ plans depend upon changes in health-care inflation trend rates, the level of benefits provided for by the plans, the future performance of assets set aside in trusts for these plans, the level of interest rates used to determine funding levels, actuarial data and experience, and any changes in government laws and regulations.⁸

In addition to increasing the sponsor's financial risk and worsening its competitive position, DB pensions can make the firm's financial statements inscrutable. Pension

² Deloitte (2006) provides a comprehensive overview of the PPA of 2006 and a review of existing funding and valuation requirements.

³ Welch et al. (2005).

⁴ Sloan. (2006).

⁵ General Motors Corporation. (2006).

⁶ Munnell et al. (2006) identify these as the four key risks firms face as DB sponsors.

⁷ OPEB includes post retirement health care and life insurance benefits.

⁸ General Motors Corporation. (2006). 21.

accounting is exceptional in its complexity, opacity, and discretion. This challenges analysts assessing the economic impact of a firm's DB plan. As such, there is debate in the literature regarding investors' ability to account properly for DB plans in firm valuation.

Any discussion on pension valuation begins with an explanation of the pension liability.⁹ There are two general levels of inclusiveness actuaries and accountants use to measure pension liability, which as of 2008, will both be discounted at a corporate bond rate.¹⁰

- Accumulated Benefit Obligation (ABO): Includes benefits for vested and non-vested employees at current salaries
- Projected Benefit Obligation (PBO): Includes benefits for vested and non-vested employees at future salaries

In measuring the above, managers are given wide discretion in their assumptions, such as future salary increases and retirement ages. As for plan assets, they are valued at an average of fair market value over the past two years, so long as this value compared to current fair value does not fall outside a 90%-110% corridor.¹¹ Ignoring the smoothing and manipulation possible in asset and liability measurements, the general economic state of the plan is the funded status: $\text{Funded Status} = \text{PBO} - \text{Plan Assets}$

Prior to December 2006, aside from footnote disclosure, funded status had little relevance for the income statement and balance sheet. Even now, if investors concentrate their analysis on the pension items disclosed on the income statement and balance sheet, it is all but certain they will err in their valuation. The income statement reflects pension expense, which is a heavily smoothed figure. The rationale for this smoothing is to insulate earnings from such erratic events as plan amendments and investment portfolio returns. The components of pension expense include:

⁹ Kieso et al. (2005) offer a summary of basic pension accounting, and we rely on this text for our income statement and balance sheet discussion.

¹⁰ Deloitte (2006) explains that firms may choose between a segmented or blended rate.

¹¹ Ibid.

- Service cost: Increase in PBO due to employees' labor
- Interest Cost: Accrued increase in liability due to time value of money
- Actual Return: Plan asset gains/losses
- Amortization of Prior Service Cost: Amortization of plan amendments
- Gain/Loss: Difference between expected and actual investment return plus recognition of unrecognized gains or losses (determined by a corridor test)

Smoothing divorces reported financials from market reality. For example, management's expected return assumptions, not actual market conditions, determine the rate of return on plan assets. Given current rules, management could essentially manufacture pension income by setting the expected rate of return on plan assets artificially well above the liability discount rate.

As for the balance sheet, the pension plan is recognized through accrual of the aforementioned smoothed pension expense figure. As a safeguard, firms must carry a minimum liability (ABO-Plan Assets) to ensure the balance sheet does not vary too greatly from economic reality. Reform recently came in December 2006, as SFAS No. 158 came into effect, which requires firms to place their plan's funded status on the balance sheet. However, this only goes so far, as the additional disclosure is made through adjusting Accumulated Other Comprehensive Income, not Assets or Liabilities. In summary, DB financial statement presentation can challenge the valuation skills of even sophisticated outsiders. This difficulty results in confusion over not only how to assess plans restructuring by freeze or termination but how to simply value plans in a basic steady state.

Over the past several decades, many companies have migrated away from providing DB coverage. A major alternative to DB plans are DC plans, such as 401(k)'s. In this system, the firm is only responsible for an annual contribution to each employee's tax deferred retirement account, in which the employee is responsible for selecting among investment

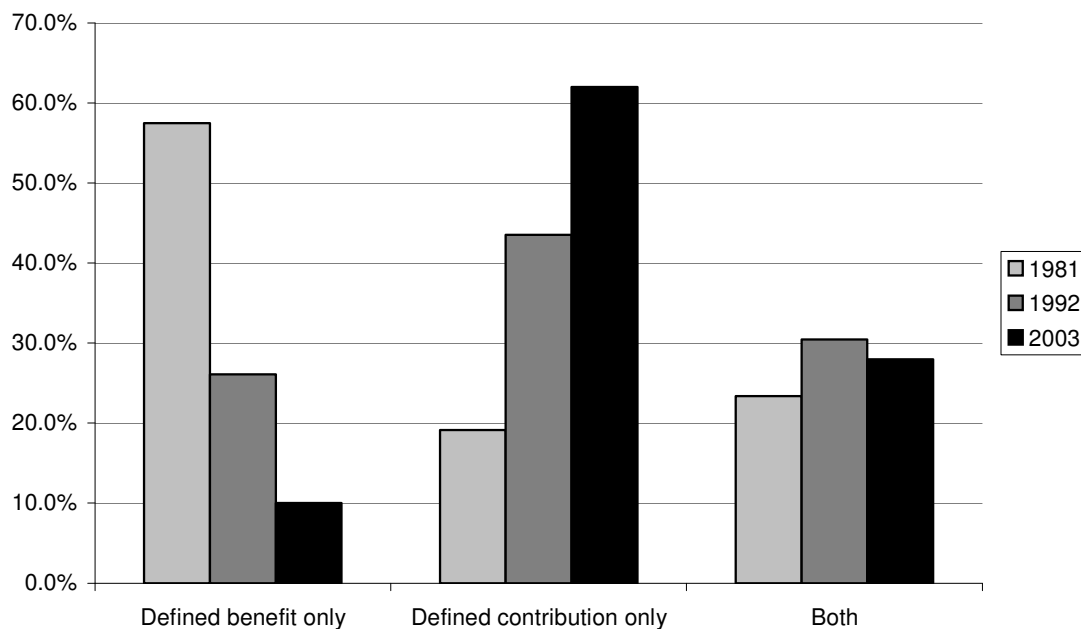
choices, generally firm stock and specified mutual funds. This type of plan is also popular among employees because it is transferable across employers, reduces the problem of job lock, and diminishes dependence on employer solvency.

Observers have long documented the tendency for firms to transition from DB to DC plans.¹² Department of Labor data reveal that the percent of firms offering only DC plans has tripled since 1981 (Figure 1). A recent Watson Wyatt study of the Fortune 1000 demonstrates how this trend has accelerated since early this decade (Figure 2). Pension Benefit Guarantee Corporation (PBGC) information on plan termination and freezes supports the above. VanDerhei (2006), citing 2004 PBGC data, finds that 168,725 DB plans terminated since 1975 (98% of which were fully funded at termination), leaving 29,000 DB plans surviving. Of these surviving plans, PBGC (2005) shows that 9.4% were hard frozen in 2003, the first year the PBGC collected freeze data. However, this freeze statistic is somewhat overstated, since hard frozen plans represent only 1.8% of active participants. A 2004 Towers Perrin study of multinational firms demonstrates the global nature of this trend. In the study, which comprised mostly of foreign sample firms, 20% of respondents had completed a freeze or termination with 29% considering such action in the near future.

¹² VanDerhei (2006) and PBGC (2005) offer summaries and analysis of many of the consultancy freeze and termination studies cited in this paper, including Aon (2003), Mercer (2006), Towers Perrin HR Services (2004), Watson Wyatt (2005) and the 2006 version of Hewitt Associates LLC (2007). The papers also cite studies not mentioned in our work, which may be of use to the reader seeking further empirical background on pension freezes.

Figure 1.

Percentage of Wage and Salary Workers with Pension Coverage by Type of Plan*



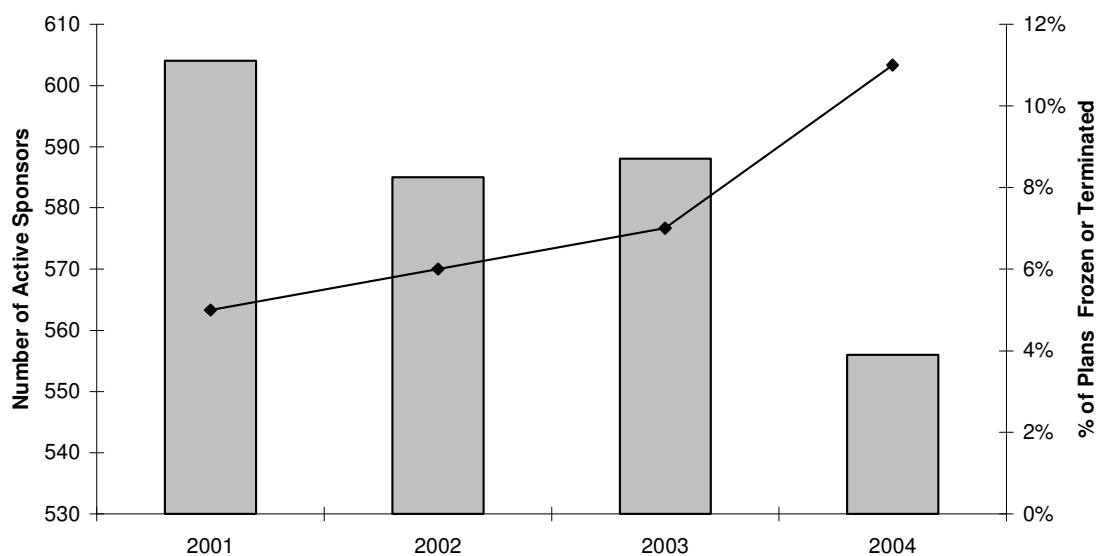
*Note: Includes plans with 100 or more participants

Source: Graphic recreated from Buessing and Soto. (2006). 3.

Data: 1981 and 1992 from Department of Labor tabulations, 2003 from CRR calculations

Figure 2.

Watson and Wyatt Analysis of the Fortune 1000



Source: Data from Watson and Wyatt. (2005).

Healthy firms seek DB liability reduction in two ways: Freeze and Standard Termination. In a standard (or fully funded) termination, a sponsor settles its pension liability by either purchasing an annuity from an insurer that roughly matches the plan's ABO (conservative actuarial assumptions make the actual termination liability larger than the ABO¹³) or by dispersing trust assets to beneficiaries in a lump sum. These terminations are generally feasible only for plans with assets exceeding the termination liability, allowing the firm to capture the surplus assets. However, this surplus is subject to a 50% excise tax (Tax Reform Act 1986).¹⁴ A plan freeze is another option sponsors have for DB liability reduction. The essence of a pension freeze is that plan participants cease to accrue benefits. Freezes can be classified into three main categories:¹⁵

- Hard Freeze: All plan participants stop accruing service benefits
- Partial Plan Freeze: A portion of participants stop accruing service benefits
- Soft Freeze: All plan participants stop accruing service benefits but salary increases continue to be earned

The Gain/Loss on a hard freeze is the difference between the PBO and ABO, as the freeze eliminates future salary increases, less Unrecognized Prior Service Cost and Unrecognized Gain/Loss.¹⁶

Often, sponsors seeking eventual termination will freeze their plan first, in order to slow the rate of liability growth and to allow assets to catch up to liabilities. PBGC (2005) found that, of plans frozen in 2003, 20% were slated for termination versus 7% for non-frozen plans. In low long-term interest rate environments such as today's, terminations are especially costly. Low interest rates elevate pension liabilities increasing the cost of

¹³ Harper et al. (2007).

¹⁴ Latter. (2006).

¹⁵ VanDerhei. (2006).

¹⁶ Latter (2006) offers an illustration of the freeze gain/loss calculation.

termination. Conversely, low discount rates increase the freeze accounting gain, by widening the difference between ABO and PBO, making freezes relatively more attractive.¹⁷

Freezes have grown in popularity since 2001, influenced by falling interest rates and declining stock prices. Unfortunately, data on pension freezes are limited. The Department of Labor did not inquire firms about plan freezes on its Form 5500 until 2002 and there is a five-year lag in data publication. However, several benefit consultancies have produced studies on the issue using client data. In a 2003 study of 1000 clients, Aon discovered that 2% of sample client plans had implemented a freeze before 2001, while 21% had taken action to freeze or were actively considering a freeze post-January 2001.¹⁸ As for the future, in late 2006, 10% of surveyed Hewitt Associates DB clients were “somewhat or very likely” to freeze their plan.¹⁹

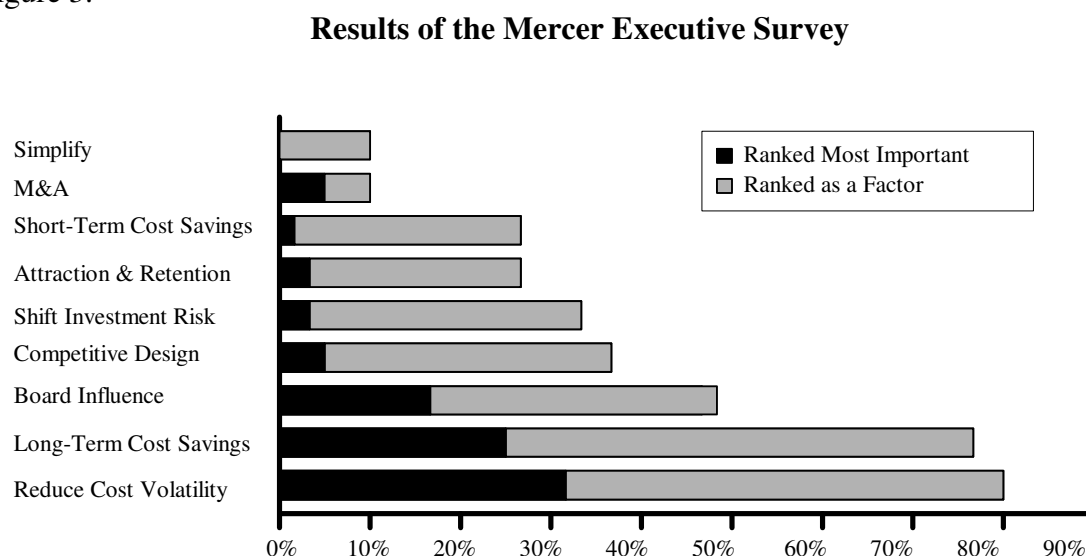
What have been the factors driving DB plans’ long decline and the recent popularity of freezes? Munnell et al. (2006) propose four primary causes: compensation reduction, increasing health care costs, financial risk, and the rise of non-qualified plans. We agree with the authors that, of these four, the most relevant based upon firm surveys and international comparisons appear to be financial risk and compensation reduction. Certainly rising health care costs and the creation of executive only, non-qualified plans have contributed to the decline; however, Munnell et al. (2006) note that nations without these issues, Canada and the United Kingdom, have also experienced an increase in freezes. In separate surveys, Mercer (2006) (Figure 3) and Aon (2003) found that managers who had recently frozen their DB plan cited “Long Term Cost Savings” and “Reduced Cost Volatility” as top reasons for their decision (Figure 3).

¹⁷ Munnell et al. (2006).

¹⁸ Aon. (2003).

¹⁹ Hewitt Associates. (2007).

Figure 3.



Source: Graphic recreated from Mercer (2006)

Today, many firms laden with DB liability find themselves at a disadvantage when competing with global rivals and start-ups not facing similar cost burdens.²⁰ Mercer (2006) notes that firms with low profit margins are more apt to freeze their plan. To bring compensation costs in line, managements have elected to reduce benefits as opposed to cutting employees' take home pay.²¹ Freezes improve the financial position of the sponsor, as the average funding requirement for DB plans is 8% of payroll, while the standard matching rate for 401(k) plans is only 3%.²² This funding requirement spread between DB and DC plans widens substantially for sponsors obliged to pay costly catch up contributions because of under-funding. However, in practice, a conversion to a DC plan will often involve some additional 401(k) contributions to indemnify the employees' freeze loss. While full indemnification estimates are very sensitive to return assumptions, this contribution could range from <2% of pay for workers in their early 30s to >18% for workers their early 60s.²³

²⁰ Munnell et al. (2006).

²¹ Ibid.

²² Ibid.

²³ VanDerhei (2006) calculates these contributions based upon an 8% asset return assumption and a Final Average annuity formula.

Empirical evidence suggests that sponsors choosing to freeze their plan are those that face the most burdensome pension obligations. Mercer (2006) found that a sample of 15 S&P 500 firms recently freezing their DB plans carried a greater contribution requirement (2 to 3 times higher), as a percent of operating cash flow, than the median S&P 500 DB sponsor. The study conjectures that this is due to low historical returns on these plans' assets. As evidence, the sample firms held a pre-freeze pension liability that was 118% larger, as a percent of total liabilities, than that of the typical S&P 500 sponsor. This research corroborates preliminary 2003 Form 5500 data analysis, finding that 48.1% of frozen plans had a funding ratio (Plan Assets/ABO) below 80% compared to 34.9% for non-frozen plans.²⁴ In other respects, these firms are healthy; Mercer (2006) found their median credit rating to exceed that of the median S&P 500 sponsor. VanDerhei (2006), in reference to the Mercer (2006) credit quality findings, observes "that some of the companies undertaking a pension freeze are doing so more out of a strategic corporate redesign than in response to immediate financial difficulties."²⁵

Besides cost pressure, another important freeze rationale is risk reduction. In a separate Mercer report, Harper et al. (2007) break financial risk into three pools: interest rate, investment, and demographic. Investors, not simply risk averse managers, should care about these risks because they all appear to be non-diversifiable or systematic. Interest rates are clearly important in the context of pensions due to the long dated discounting of future cash flows. Harper et al. (2007) estimate that a 100bp decline in long-term interest rates increases plan liabilities by between 15% and 20%. Investment risk and the impact of fluctuating capital markets have been especially apparent in the past decade. With a large percentage of plan assets invested in equities, many plans in fact required no contributions in the late

²⁴ Pension Benefit Guaranty Corporation. (2005).

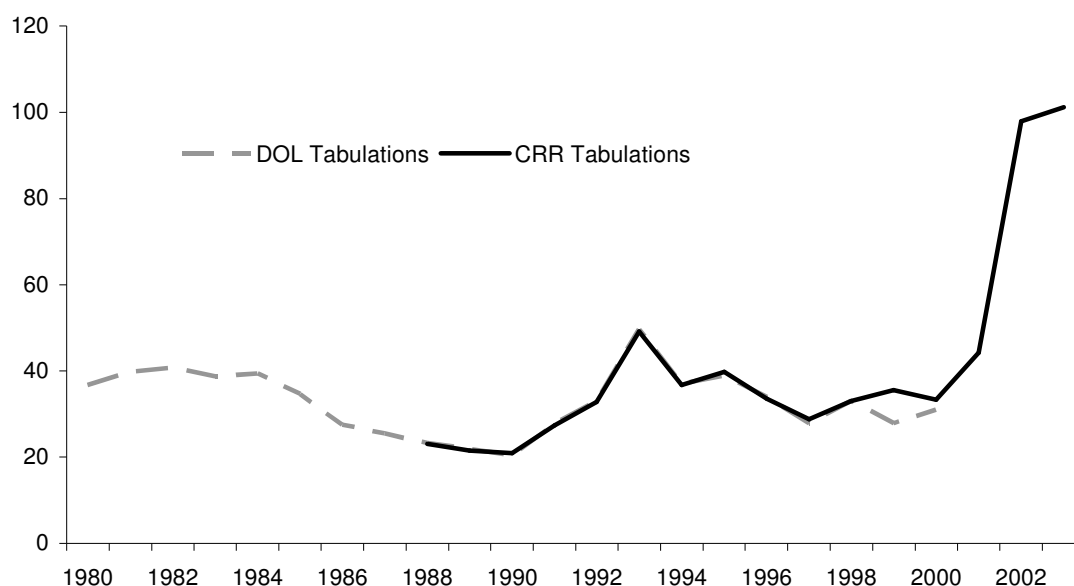
²⁵ VanDerhei. (2006). 6.

1990s.²⁶ However, as stock prices and interest rates fell in 2001, plan liabilities rose just as asset values deteriorated. This resulted in a surge in contributions (Figure 4) and brought to light the systematic risk DB plans create for their sponsors. GM outlines in its 2006 10K the investment and interest rate risk it faces as one of the nation's largest plan sponsors:

In addition, our employee benefit plans hold a significant amount of equity securities. If the values of these securities decline, our pension and OPEB expenses would increase and, as a result, could materially adversely affect our business. Any decreases in interest rates, if and to the extent not offset by contributions and asset returns, could increase our obligation under such plans. We may be legally required to make contributions to the pension plans in the future, and those contributions could be material.²⁷

Figure 4.

Pension Plan Contributions to Defined Benefit Plans*



*Note: Plans with 100 or more participants.

Source: Graphic recreated from Buessing and Soto. (2006). 2.

(Identical graphic cited in Munnell et al.)

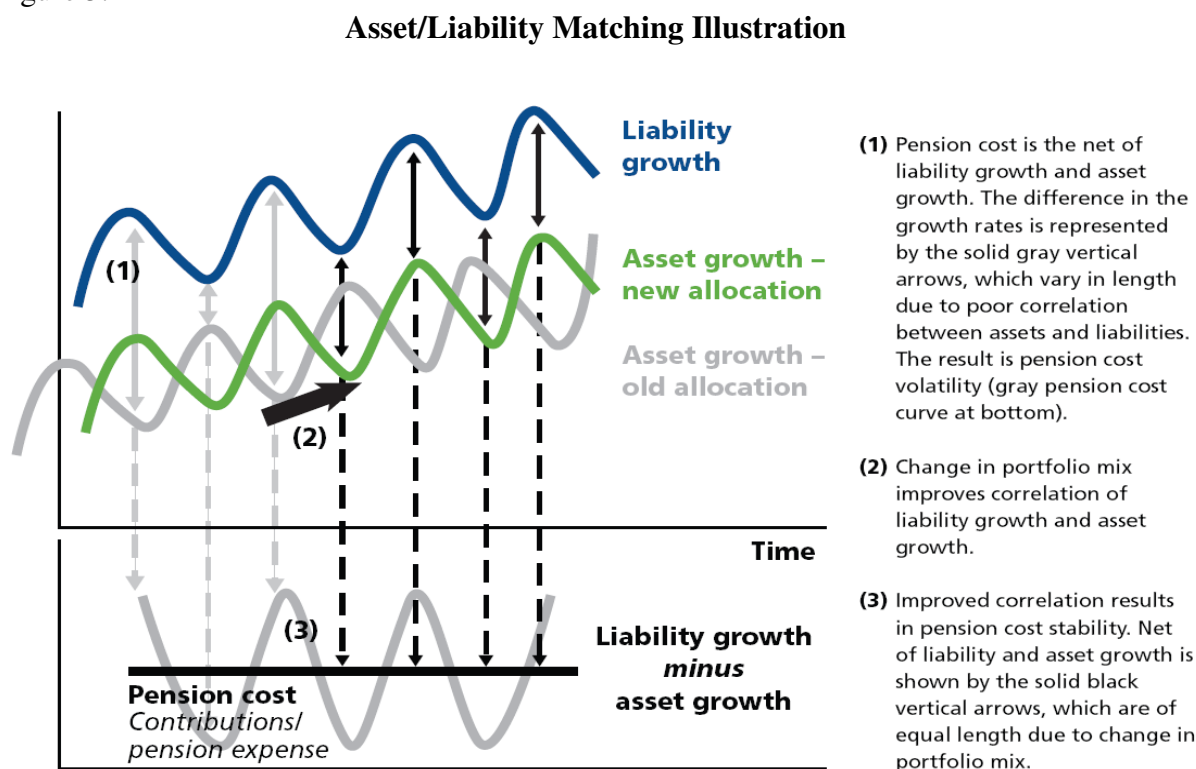
A freeze reduces investment and rate risk in several ways. First, a freeze shrinks the size of plan liabilities. The liability will now be the ABO instead of the larger PBO. In addition, liabilities will grow more slowly, as benefit accruals cease and interest costs

²⁶ Munnell et al. (2006).

²⁷ General Motors Corporation. (2006). 21.

decline. Second, with improved plan solvency, restructuring plan investments to asset/liability match is more likely.²⁸ Asset/liability matching in this case means that the firm uses low volatility fixed income investments to hedge rate risk and to lower investment risk (Figure 5).²⁹ Harper et al. (2007) argue that freezes make matching more likely because post-freeze plans are more solvent, reducing the need to take on high risk/high return investments. A fully funded plan benefits little from high risk/high return investments because any over funding is restricted to being applied to future obligations³⁰ or will be subject to a 50% excise tax at termination. Finally, many plans freeze simply as a prelude to termination, the ultimate risk reduction, perhaps waiting for the investment cycle to turn.

Figure 5.



Source: Graphic taken from Harper et al. (2007). 4.

Demographic risk is an additional problem for plan sponsors. This risk principally includes the accuracy of actuarial assumptions. However, Harper et al. (2007) place the

²⁸ Harper et al. (2007).

²⁹ Ibid.

³⁰ Ibid.

magnitude of this risk well below that of interest rate and investment risk. This is may be true through the medium term, but Munnell et al. (2006) suggest that long-term actuarial assumptions may be less accurate, with the risk to the downside (e.g. life span estimations could be too low). Even so, this problem will be slow to impact the pension system and is an unlikely motivation for today's managers. More relevant to current sponsors is the risk of changing pension legislation or accounting rules.³¹ Unfortunately, for sponsors, the political pressure for these changes is often highest when DB plans are financially weak. The Pension Protection act of 2006 and FASB No. 158 are recent examples of rule making risk.³² Firms most exposed to this problem are those with the least solvent plans, providing additional motivation for them to freeze in advance of any new regulation. Mercer (2006) found that under FASB No. 158 its sample of S&P 500 freeze firms stood to lose 7% of Shareholder's Equity versus 2% for the median S&P 500 plan sponsor.

If, as argued above, a desire to reduce systematic risk and improve cost structure motivates pension freezes, then it is reasonable to believe that freezes might create value. This paper tests the hypothesis that healthy firms experience an increase in firm value as a result of freezing their DB pension plans. We define freeze here to include not simply the actual DB freeze but also the introduction of a revised retirement plan, typically a 401(k) plan with some indemnification properties.³³ In addition, a freeze in this paper includes closing plans to new entrants. We focus on healthy firms, since changes in their value will be concentrated in equity and because market model parameter estimates will be more accurate. This paper is foremost an examination of the effect of pension freezes on firm value, but the question of market efficiency becomes important since we rely on market value to infer changes in underlying firm value. Efficiency is also significant from the viewpoint of practitioners, both investors and managers.

³¹ Munnell et al. (2006).

³² Ibid.

³³ Ibid.

Assuming semi-strong efficient markets³⁴, we would expect investors to incorporate immediately and accurately the effect of freezes into market value. If the market is semi-strong efficient, then we can interpret the unexplained market value change on the announcement date as freeze created value. However, pensions are complex and some researchers suggest investors do not accurately account for their impact on firm value, so markets may be inefficient. If markets are not efficient, but freezes do create value, then we would expect investors to delay pricing freeze generated firm value. In other words, to measure this value creation, we would have to examine a greater number of post announcement trading days than if the effect was priced efficiently.

The literature is unsettled in assessing the market efficiency of pension valuation. Coronado & Sharpe (2003) come down on the side of inefficient pricing and conclude that investors err in pension valuation by capitalizing plans' contribution to accounting earnings, as opposed to examining funded status. The paper claims the effect resulted in investors overvaluing firms by as much as 5% after the technology bubble burst, when expense smoothing protected pension earnings from asset losses. Picconi (2006) also finds evidence of inefficiencies. He shows that investors fail to properly value both changes in plan assumptions, as well as the off balance sheet pension liability. On the other side of the debate, Brown (2004) argues that the market properly discounts firm value when managements make unrealistic pension assumptions. Older studies from the 1980s demonstrate that share prices faithfully reflect unfunded pension liabilities³⁵. The academic debate over efficient pricing broadens the interest of this study beyond testing for an increase in firm value to observing the time it takes for this possible change to occur.

³⁴ Ross et al. (2005) define a semi-strong efficient market as one where prices fully reflect all publicly available information. This implies that prices instantaneously adjust to incorporate the release of new public information.

³⁵ Bulow, Morck & Summers. (1985).

Methodology

This paper uses an event study analysis to test the value creation hypothesis. Given efficient markets, the abnormal return measured after the event date should equal the economic impact of the event.³⁶ MacKinlay (1997) notes that this procedure is often superior to examining operational data, which may take years to reflect a corporate action. Event studies do rely on efficient markets; however, even if markets are not perfectly semi-strong efficient, it is likely that prices will adjust to correct values over a long enough test interval. To perform the analysis, we used the Eventus software and CRSP database.

Gathering a list of sample events proved difficult. Freezes are too recent to be included in available DOL Form 5500 data and announcement mechanisms vary by company. To date, studies on freezes have relied upon private consulting firm data.³⁷ Fortunately, Boston College's Center for Retirement Research has created a database of healthy company freezes from aggregating publicly available information.³⁸ This list of 20 or so freezes from 2003 through 2006 was the genesis of the two test portfolios used in this study. Because of uncertainty regarding market efficiency, we examine the hypothesis over both long and short-term test intervals. We created separate portfolios for the long and short-term analysis (Table 1). Both portfolios exclude samples with the following characteristics: foreign firms, private firms, and firms with a merger that occurred during the test or estimation interval³⁹. In addition to the aforementioned conditions, the long-term portfolio excludes freezes occurring in late 2006, to ensure that each firm has at least 200 trading days of post announcement returns. The short-term portfolio includes the late 2006 freezes but

³⁶ MacKinlay. (1997).

³⁷ Pension Benefit Guaranty Corporation. (2005).

³⁸ Center for Retirement Research at Boston College (2007) maintains an on going database of major healthy company freezes. The database includes fact sheets on each freeze with basic information such as plan type, number of participants affected, description of freeze, plan solvency, financial implications, dates (announced and effective) and background. The database is available on the CRR website.

³⁹ We made an exception on the M&A criterion for Sears, which announced a merger with K-mart late in the test interval (Nov. 2004).

excludes freezes announced within one day of an earnings release date. We define the event date as the first trading day on or after the announcement date.⁴⁰

Table 1.

Events Considered for Inclusion

Included Events					
Firm	Freeze Date	Effective Date	Freeze Type	LT Port.	ST Port.
Aon	10/28/2003	1/1/2004	New Empl.	Yes	Yes
Sears Roebuck	1/28/2004	1/1/2005	Partial	Yes	No (Earnings)
NCR	5/26/2004	9/1/2004	Partial	Yes	Yes
Circuit City Stores	10/29/2004	2/28/2005	Total	Yes	Yes
IBM	12/9/2004	1/1/2005	Partial	Yes	Yes
Motorola	12/17/2004	1/1/2005	New Empl.	Yes	Yes
Hewlett-Packard	7/19/2005	1/1/2006	Partial	Yes	Yes
Lockheed Martin	10/6/2005	1/1/2006	New Empl.	Yes	Yes
Verizon	12/6/2005	6/30/2006	Partial	Yes	Yes
IBM	1/6/2006	1/1/2008	Total	Yes	Yes
ALCOA	1/17/2006	3/1/2006	New Empl.	Yes	Yes
Lexmark International	1/24/2006	4/2/2006	Total	Yes	No (Earnings)
Ferro	2/16/2006	4/1/2006	Total	Yes	Yes
Coca-cola Bottling	2/27/2006	6/30/2006	Total	Yes	Yes
DuPont	8/28/2006	1/1/2007	Partial	No (Date)	Yes
Hershey	10/10/2006	1/1/2007	Partial	No (Date)	Yes
Citigroup	11/3/2006	1/1/2008	Partial	No (Date)	Yes
Excluded Events					
Firm	Freeze Date	Reason for Exclusion			
Sprint Nextel	Nov. 2005	Estimation period is pre Nextel purchase (12/15/2005, announced 8/15/2005)			
Hospira	Q2 2004	Freeze was in association with spin-off from Abbott			
Sears Holdings	5/9/2005	Estimation security is K-mart, which was emerging from Ch.11 at the time			

Sources: Center for Retirement Research (2007), news articles, SEC filings, and press releases.

Calculating abnormal returns requires a return estimation model; and in this analysis, we rely upon the familiar single-factor market model:⁴¹

$$R_{jt} = \alpha_j + \beta_{mt} + \varepsilon_{jt}.$$

R_{jt} is the return of the j^{th} sample on day t . The error term has expected value zero.

Parameters are estimated using ordinary least squared regression. The event date is $t=0$. The estimation interval, $t = [-31, -286]$, is approximately one year and does not overlap the test

⁴⁰ We determined the event date by analyzing Center for Retirement Research pension fact sheets, company press releases and filings as well as media reports.

⁴¹ Cowan (2005) is our source for market model and Eventus return formulas.

interval. The market portfolio is the CRSP Equal Weighted Index. According to the above estimation model, the daily abnormal returns or prediction error is A_{jt} :

$$A_{jt} = R_{jt} - (\alpha_j + \beta_j R_{mt}) .$$

Eventus reports two abnormal return statistics for the sample firms over the test interval $[T_1, T_2]$: Cumulative Abnormal Average Return (CAAR) and the Average Compound Abnormal Return (ACAR). The CAAR calculation begins with determining each sample's Average Abnormal Return (AAR) over N trading days:

$$AAR_{T_1, T_2} = \sum_{j=1}^N A_{jt} / N .$$

These AARs are then aggregated across all, N , samples to form the CAAR:

$$CAAR_{T_1, T_2} = (\sum_{j=1}^N \sum_{t=T_1}^{T_2} A_{jt}) / N .$$

To calculate the ACAR, we need to first determine the daily buy and hold abnormal return (BHAR) for each sample:

$$BHAR_{j, T_1, T_2} = [\prod_{t=T_1}^{T_2} (1 + R_{jt}) - 1] - [(1 + \alpha_j)^{(T_2 - T_1 + 1)} - 1] - \beta_j [\prod_{t=T_1}^{T_2} (1 + R_{jt}) - 1] .$$

These BHARs are then aggregated across all samples to form the CAAR:

$$ACAR_{T_1, T_2} = (\sum_{j=1}^N BHAR_{j, T_1, T_2}) / N .$$

CAAR is the most reasonable method for aggregating returns and calculating test statistics but Eventus reports the ACAR to simulate the return an investor would realize implementing this strategy. The test statistics calculated for the returns are a Patell $-Z$ Test

and a Generalized Sign Test.⁴² The Patell $-Z$ Test standardizes each security's standard error and assumes cross sectional independence among the samples. The null hypothesis for the Patell- Z Test is $CAAR_{T_1, T_2} = 0$, while the Generalized Sign Test compares the percent of samples with positive AAR in the estimation and test intervals. The expected abnormal return is positive; therefore, all Z -scores are converted to p -values on a one-tailed basis

Our analysis examines three sets of test intervals, or windows: Pre-Announcement, Event Straddle, and Post-Announcement. The Pre-Announcement window, $t = [-30, -1]$, tests the state of the firm pre-announcement and for information leakage. The Event Straddle, $t = [-1, +1]$, tests for short term announcement reaction and controls for information leakage and announcement date uncertainty. The Post-Announcement intervals, $t = [+1, +50]$, $[+1, +150]$, $[+1, +200]$ and $[+1, +250]$, test for long-term announcement reaction and possible market inefficiency.

⁴² See Cowan (2005) for details on test statistic calculations.

Event Study Summary Results

Table 2.

Short Term Portfolio Results

Windows	Events	ACAR	CAAR	Patell Z-Score	p-value	CAAR Pos:Neg	Sign Z-Score	p-value
(-30,-1)	15	1.68%	1.82%	0.757	0.2244	9:06	0.928	0.1767
(-1,+1)	15	-0.06%	-0.05%	-0.107	0.4575	9:06	0.928	0.1767
(+1,+50)	15	-0.65%	-0.33%	0.818	0.2068	8:07	0.411	0.3404

Table 3.

Long Term Portfolio Results

Windows	Events	ACAR	CAAR	Patell Z-Score	p-value	CAAR Pos:Neg	Sign Z-Score	p-value
(-30,-1)	14	0.82%	1.07%	0.671	0.2511	9:05	1.183	0.1185
(-1,+1)	14	0.40%	0.43%	0.284	0.3883	8:06	0.648	0.2585
(+1,+50)	14	-2.68%	-2.22%	-0.011	0.4957	6:08	-0.422	0.3367
(+1,+150)	14	14.38%	15.44%	3.104	0.001	11:03	2.252	0.0122
(+1,+200)	14	20.04%	22.03%	3.986	<.0001	12:02	2.787	0.0027
(+1,+250)	14	21.90%	25.60%	4.423	<.0001	12:02	2.787	0.0027

Windows	Events	ACAR	CAAR	Patell Z-Score	p-value	CAAR Pos:Neg	Sign Z-Score	p-value
(-30,-1)	14	0.82%	1.07%	0.671	0.2511	9:05	1.183	0.1185
(0,+50)	14	-2.11%	-1.54%	0.21	0.4167	7:07	0.113	0.4549
(+51,+100)	14	9.70%	9.66%	2.655	0.004	10:04	1.718	0.0429
(+101,+150)	14	7.90%	8.00%	2.733	0.0031	14:00	3.857	<.0001
(+151,+200)	14	6.20%	6.58%	2.596	0.0047	10:04	1.718	0.0429
(+201,+250)	14	2.90%	3.57%	1.923	0.0272	10:04	1.718	0.0429

=Significant at 5%

Figure 6.

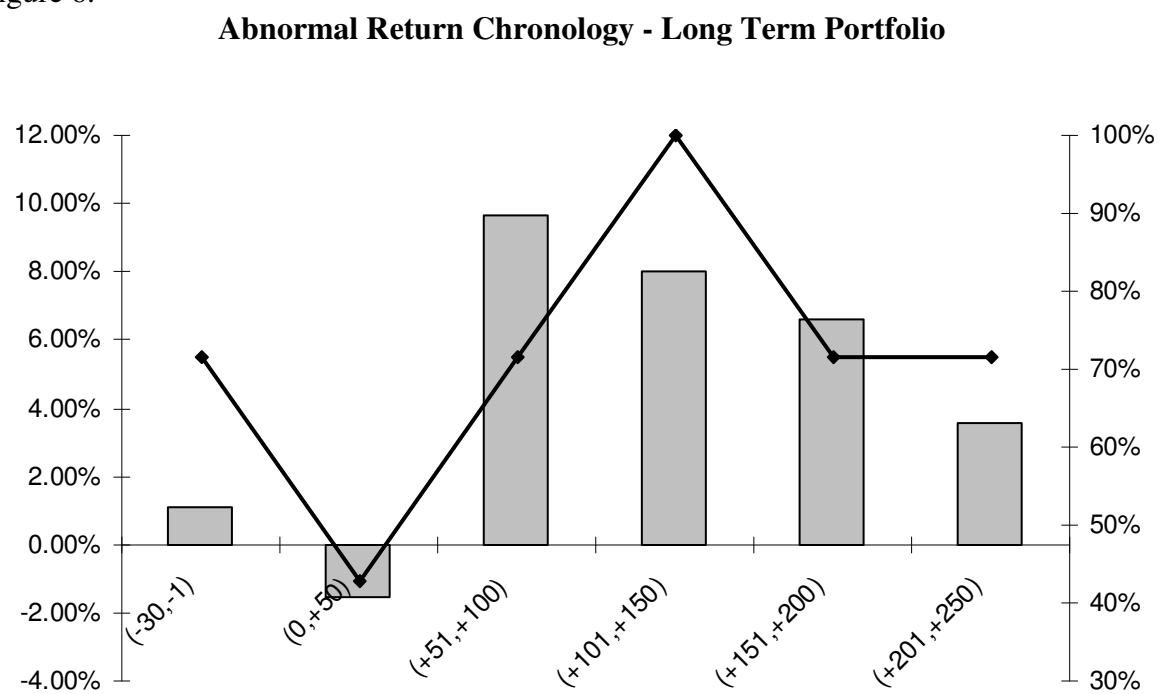


Figure 7.

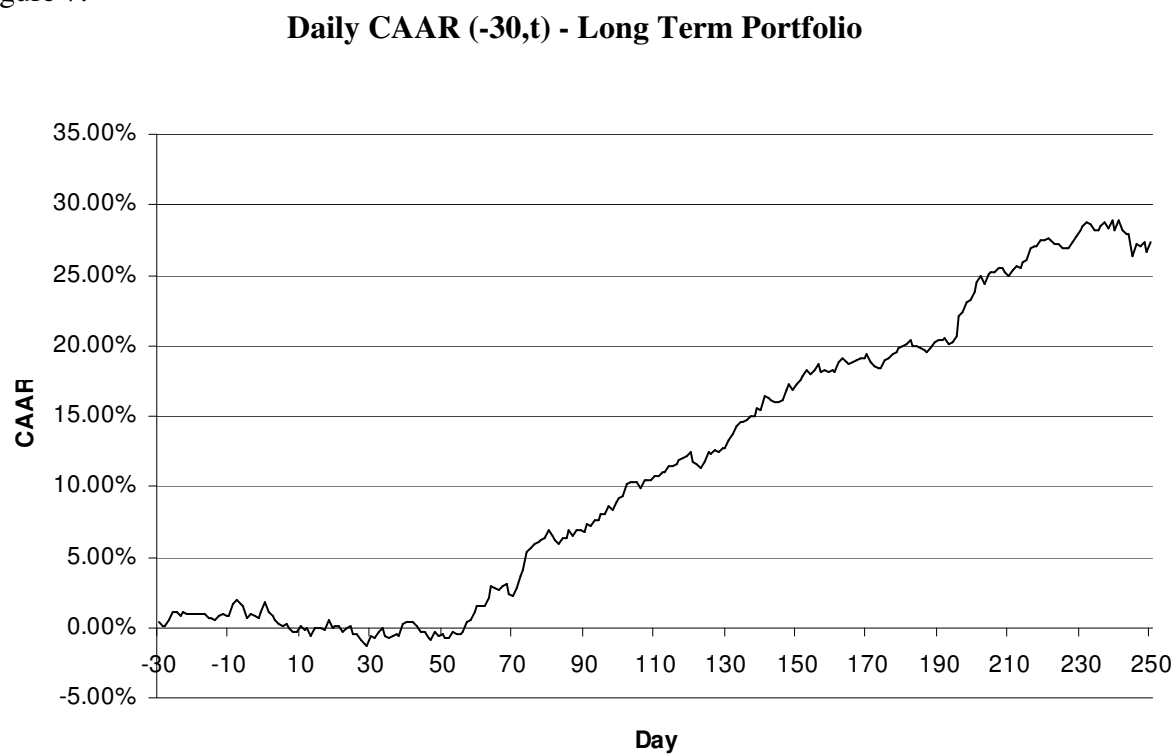


Table 4.

Sample Level CAAR - Long Term Portfolio

Event	Window							Trading Days
	(+0,+250)	(0,+50)	(+51,+100)	(+101,+150)	(+151,+200)	(+201,+250)	(-30,-1)	
Lexmark International	94.05%	8.23%	33.38%	16.18%	19.29%	16.96%	-0.96%	236
Coca-cola Bottling	56.94%	3.24%	28.67%	15.01%	4.76%	5.26%	7.12%	213
Verizon	43.18%	12.78%	-1.18%	11.14%	20.47%	-0.03%	7.64%	250
Aon	39.50%	2.27%	23.00%	18.05%	9.31%	-13.13%	0.45%	250
Lockheed Martin	29.82%	4.04%	8.50%	0.09%	8.74%	8.44%	-4.82%	250
ALCOA	22.52%	5.51%	11.84%	2.95%	-1.85%	4.08%	2.15%	241
NCR	21.28%	-3.69%	10.66%	1.68%	12.24%	0.39%	9.21%	250
IBM (2006)	21.22%	-0.20%	-0.53%	2.13%	14.95%	4.87%	-7.00%	247
Hewlett-Packard	20.35%	12.82%	0.61%	5.07%	-3.13%	4.98%	4.50%	250
Motorola	18.76%	-11.79%	17.65%	5.71%	7.49%	-0.30%	-1.81%	250
Sears Roebuck	17.26%	-9.94%	3.87%	8.21%	9.30%	5.82%	-14.79%	250
Ferro	9.13%	-8.87%	-2.15%	17.29%	5.59%	-2.73%	0.63%	219
IBM (2004)	-4.59%	-4.12%	-12.60%	2.96%	-5.48%	14.65%	3.63%	250
Circuit City Stores	-21.59%	-31.90%	13.51%	5.59%	-9.50%	0.71%	9.11%	250
CAAR	26.27%	-1.54%	9.66%	8.00%	6.58%	3.57%	1.08%	

Results Discussion

While the independent variable, abnormal return, eventually moves in the expected direction (up), the reaction is both prolonged and delayed. Results from the short-term portfolio fail to disprove the null hypothesis (Table 2). Even when controlling for announcement method (press release/news report or SEC filing) and including an announced projected financial improvement dummy variable, the short-term results are insignificant. Despite a flat performance 50 days post freeze, the CAAR leaps almost 10% in the next 50 days [+51, +100], and rises at a decreasing rate over the next seven months (Tables 3 and 4). Through day 250, the sample generates a CAAR that is significantly positive (25.60%, $p < .0001$). Not only is this return positive, but the results reflect wide breadth (12 of 14 are positive) across the sample, indicating the analysis does not hinge on one particular case. In addition, the chronology of stock price reaction is fairly uniform across samples, demonstrated by the breadth of stability and strength in the [+1, +50] (50% positive) and [+51, +100] (79% positive) periods, respectively.

The lagged price rise may represent market inefficiency. If the study properly isolates the freeze effect, then the market delays in pricing pension freeze benefits. This result

supports prior research questioning investor ability to incorporate complex pension data accurately. With pension freezes specifically, the lagged response may be a result of the accounting rules governing gain and loss recognition. Under SFAS No. 88, curtailment gains are recognized as realized (freeze effective date), while losses are recognized at commitment date (announcement date). In the sample, the average difference between the effective and announcement dates is 152 calendar days. Including the 10K/Q publication delay, the accounting rule results in a nearly 6-month lag in potential gain recognition. In addition, annual, not quarterly, disclosure of detailed pension data in the financial statement notes allows sponsors to delay publication of the freeze impact for a substantial period.

Even when disclosed, Picconi (2004) finds that investors and analysts take time to incorporate new and complex pension information. His paper specifically addresses changes in pension plan rate assumptions. The study finds that investors and analysts alike wait many months, until the change in assumptions impacts quarterly earnings, to modify their financial expectations:

Rather than specifically gleaning the information by referring to the disclosed information, both investors and analysts seem to gradually incorporate this information by observing its effects on earnings. Since all this information is publicly available, information assimilation would appear to drive this inefficiency.⁴³

This explanation may be weaker with respect to freezes, which are widely covered in the financial press and analyst community. However, such findings offer insight into what mechanisms may be responsible for our results.

Researchers should examine the results recognizing that the delayed response increases the possibility that a confounding variable is at least partially responsible for the reaction. The pension freeze itself may be a leading indicator for another, more causal variable, making the correlation discovered above spurious. For example, pension freezes may be positively correlated with the introduction of good management practices. In the case

⁴³ Picconi. (2004). 26.

of Hewlett-Packard, successful CEO Mark Hurd froze the pension plan three months into the job. He came to HP after an acclaimed stint at another sample firm, NCR, where he also froze the pension plan. Perhaps, today's most competent managers are freezing their DB plans, creating value in the process, but much of the observed value creation is a result of their other actions. As an aside, the Mark Hurd example introduces another potential problem: HP's freeze was widely anticipated when Hurd was hired as CEO, given his history at NCR.⁴⁴ Fortunately, we have no information that the market expected freezes in the other sample firms; insignificant abnormal returns over the [-30, -1] window support this assumption.

Another potential lurking variable is the influence of other restructuring activity. Almost all of the sample firms were in the midst of a restructuring program, of which a pension freeze was simply one component (not surprising given the freeze motivations discussed earlier) (Table 5). It may be that freezes are simply an indication of a successful restructuring program but in and of themselves do not create much value. For example, freezes may indicate weak or non-existent unions, allowing for deeper and more significant cost cutting measures. In fact, PBGC (2005) found that 7% of union plans reported a hard frozen status in 2003 compared with 10% for non-union plans. Alternatively, freezes could designate a willingness on management's behalf to take unpopular but necessary action to cut costs. Eight of the thirteen samples reporting a restructuring made their major restructuring announcement after or on the freeze date, creating considerable risk that restructuring announcements contaminated the test interval. Even restructurings announced before the freeze event have the chance to influence our results. Unfortunately, layoffs and plant closings are more uncertain than pension freezes and investors may wait for realization of firms' initial restructuring plans before capitalizing any of their projected effect.

⁴⁴ CNN/Money.com. (2005).

Table 5.

Sample Firm Non-Freeze Restructuring Activity Summary

Announcement Dates			
Firm	Freeze	Restructuring	Restructuring Summary
ALCOA	1/17/2006	Jan-05	Layoff 8100 workers by mid 2006
Aon	10/28/2003	Feb-04	Cut Overhead: 600 IT jobs outsourced, reduce regional offices
Circuit City Stores	10/29/2004	Feb-05	Close 19 stores and 1 distribution center
Coca-cola Bottling	2/27/2006	NA	NA
Ferro	2/16/2006	Jul-06	Reduce costs \$40-\$60 million per year by 2009, asset write-offs, layoffs
Hewlett-Packard	7/19/2005	Jul-05	14,500 employees laidoff, considered "expected"
IBM	1/6/2006	May-05	Layoff 10,000-13,000 workers (4% of labor force), reorganize european ops.
IBM	12/9/2004	May-05	Layoff 10,000-13,000 workers, reorganize European management
Lockheed Martin	10/6/2005	Apr-04	Layoff 800 to 1,000 workers
Motorola	12/17/2004	Oct-05	Layoff 1,900 workers, improve material procurement
NCR	5/26/2004	Nov-02	Layoff 1,500 workers (5% of labor force), reduce expenses by \$100 million
Verizon	12/6/2005	Feb-05	Layoff 7,000 workers post MCI Inc. acquisition
Sears Roebuck	1/28/2004	Jul-04	Layoff 3,300 workers (2% of labor force), cut 64,000 jobs since 2000
Lexmark International	1/24/2006	Jan-06	Layoff 275 workers

Restructuring information was gathered from press releases, SEC filings, and news articles.

The general confounding variable concern is that much of the observed value creation comes from activities apart from the pension freeze. Even so, if the sample freezes are both value enhancing and unexpected (both reasonable assumptions), then at least a portion of the lagged response is freeze created. This leaves us to question the magnitude of the freeze related inefficiency, not its very existence.

Overall, the study's findings of market inefficiency and freeze value creation support both prior literature and economic logic. However, in an abundance of caution, we have also tested for evidence of the preceding forewarnings. If freezes truly are value enhancing, then the event study results ought to be sensitive to variables that we would expect to influence the economic impact of the freeze (e.g. type of freeze, funded status, size of plan). Unfortunately, controlling for identified differentiating variables offers no further insight on the long or short-term results. Yet this result should not discredit the general findings. These are imperfect measures of the financial impact of a freeze, because such figures themselves are subject to substantial accounting smoothing and may be unrealistic.

From a statistical point of view, one concern is that the market model parameter values changed between the estimation and test periods. Practitioners sometimes use a

rolling beta estimate to overcome this problem. Eventus offers a methodology entitled Event Parameter Approach to allow joint estimation of model parameters and abnormal returns.⁴⁵ This test yields a $CAAR_{(0, +200)}$ of 22.98% (.009% p-value), implying the results of the original study are robust to joint estimation. Another statistical concern is the independence of abnormal returns and the event date.⁴⁶ Abnormal returns several hundred days before the event date are not statistically significant in either direction, supporting the independence assumption.

A final potential problem is clustering or the possibility that the sample CAARs do not have zero covariance. The Patell-Z test makes the assumption that covariance among the samples CAARs is zero. This could be a significant issue for the study because several of the long term test intervals overlap. One possible solution would be to examine each of the sample CAARs independently, without aggregation.⁴⁷ Another suggested approach is to categorize the events by date to form non-overlapping portfolios.⁴⁸

Potential Further Research

The spurious correlation problem leads to several potential ways to continue this research. One obvious extension is to examine the good management and restructuring lurking variable explanations. Management's non-freeze activity could be studied by observing the samples' change in operating margins (ex. pension expense) relative to the industry. Another way to test the lurking variable question would be to estimate the present value of the freeze directly as opposed to inferring it from market data. This estimation may be carried out using the financial projections firms often release as part of their freeze announcement.

⁴⁵ Cowan. (2005).

⁴⁶ Dwyer. (2001).

⁴⁷ Mackinlay. (1997).

⁴⁸ Ibid.

Expanding the sample size would increase both the study's power and possibly allow for separate, non-overlapping portfolios to address clustering. A researcher could attempt to find additional samples through currently available public information (e.g. press releases, SEC filings, etc...) or wait for post 2002 Form 5500 data releases. Finally, the parameter drift concern could be addressed more completely by performing a full event parameter study.

Conclusions

Our research demonstrates a powerful lagged relationship between excess positive returns and DB freezes. The results confirm prior expectations and existing literature, leading to the observation that the relationship is casual. Even if the association is not causal, the potential that DB freezes are in some way related to other variables influencing firm value is interesting in its own right. This study may disappoint executives hoping a DB freeze will result in a clear and immediate boost in market value. Regardless, the market eventually realizes the benefits of switching from a DB to DC regime through the freeze mechanism. Investors' verdict on this issue will only hasten the decline of DB plans.

Investors may value the results of this research the most. Irrespective of the ultimate causation, the substantial and consistent delayed price reaction presents an investment opportunity. Unfortunately, for the perceptive investor, this inefficiency may not persist given the recent regulatory changes aimed at improving pension transparency and financial statement recognition. Recreating a similar study several years from now will give some indication if modifications to accounting standards have the effect of correcting pension related market distortions.

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